



Office of Science Budget Highlights

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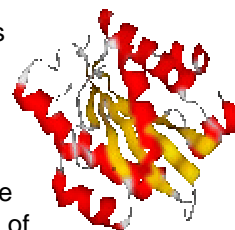
The Office of Science requests \$3,159,890,000 for FY 2002 in the “Science” appropriation, an increase of \$4,436,000 over FY 2001; and \$8,970,000 within the “Energy Supply” appropriation. This budget will support thousands of individual research projects at hundreds of research facilities across the United States, primarily at the Nation’s research universities and DOE’s national laboratories.

The Office of Science is the dominant supporter of the physical sciences in the U.S. and plays a major role in supporting other scientific fields, including the life sciences, mathematics, computation, engineering and environmental research. We are a principal supporter of graduate students and postdoctoral researchers in their early careers, and we manage a vast network of major scientific facilities that are essential to the vitality of the U.S. research community. Tens of thousands of the leading research scientists in the U.S. – representing virtually every scientific discipline – depend upon the Office of Science to maintain and operate these unique facilities. FY 2002 funding of the Office of Science’s basic research portfolio supports the President’s goal of strengthening the U.S. scientific enterprise to ensure continued international leadership in technological innovation, and DOE missions in energy, environment, and national security.



Genomes to Life is a quest to understand the biochemical networks that carry out the essential processes of living organisms using microbes. The program will identify the multiprotein molecular machines that carry out the functions of living systems, characterize the regulatory networks controlling these molecular machines, characterize the functional repertoire of microbial communities in their natural environments, and develop computational capabilities needed to model the complexity of biological systems. *Genomes to Life* represents a fundamental change in the way biologists think about and do biology. It capitalizes on the successes of the human genome project and on DOE strengths and will advance all of biology while addressing DOE mission needs in energy, the environment and worker protection.

Complex molecular machines are being studied by the Office of Science’s structural biology program, which has developed the most productive experimental stations for determining the structure of proteins and other biological macromolecules at the DOE synchrotron light sources. These instruments not only are producing information about the three-dimensional structures of these key molecules, but also are enabling understanding of the complex molecular machines that actually carry out the essential processes of all life.



Finding the Higgs boson and measuring its properties are key to understanding the source of mass for quarks and leptons, the fundamental constituents of matter. Fermilab’s Tevatron Collider will bring “Run II” into full swing in FY 2002 and will begin accelerator improvements. The prospects for discovery are great during Run II, which will continue through FY 2007 and

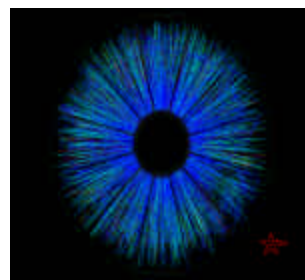


will require a four-year program of accelerator and detector upgrades to exploit its full potential. Mounting evidence suggests that the long-sought Higgs boson may be within the ultimate reach of the Tevatron Collider and its two large detectors, CDF and D-Zero.

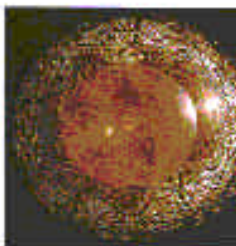
The vast preponderance of matter over antimatter in the universe could be explained by work being done at the Stanford Linear Accelerator Center's B-factory and its BaBar detector through the study of B mesons. Electrons colliding at several

billion electron volts (GeV) will allow the study of an asymmetry known as Charge-Parity (CP) violation, discovered in K-meson decays in 1964. CP violation is not yet fully understood, but is believed to be at least partly responsible for the excess of matter over antimatter. The question is whether it provides the entire explanation or is there some additional, unknown cause. Investigating this important asymmetry will substantially extend our understanding of elementary particles.

The primordial soup of quarks and gluons believed to have existed in the first moments of the universe are being studied at the Relativistic Heavy Ion Collider (RHIC), now in full operation at Brookhaven National Laboratory. RHIC was designed to form submicroscopic specimens of quark-gluon plasma by colliding atomic nuclei. The FY 2002 experimental run at this unique facility will provide the first in depth opportunity to explore this exciting area of physics.



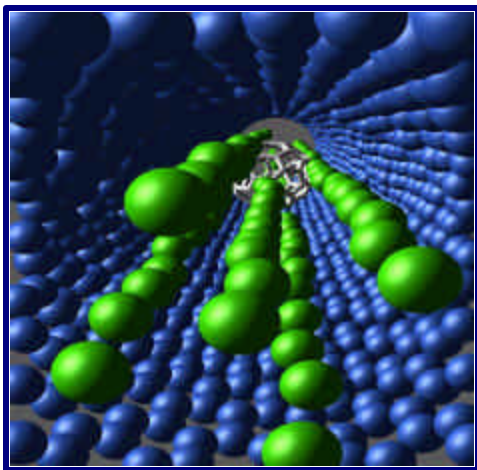
Revolutionary insights into the properties of neutrinos and the core of the sun will be possible through work at the Sudbury Neutrino Observatory (SNO), a 3-year multi-national program. The experiment is investigating whether neutrinos change from one neutrino type to another ("oscillate") during their journey from the sun to the SNO detector. If neutrinos oscillate, they must have mass. The information gathered about neutrinos from the sun will also lead to better understanding of the thermonuclear reactions that fuel the sun.



Capturing the sun's power here on earth could be accomplished using helical magnetic fields in toroidal shapes, which confine spiraling plasma particles at temperatures exceeding 100 million degrees, or ten times hotter than the core of the sun. Experiments at DOE's unique national facilities will test the theoretical understanding of how stable, long-lasting, hot plasmas can be sustained with minimum energy loss to the surrounding vessel. These plasmas are subject to turbulence and complex non-linear oscillations. During the past few years, experiments using sophisticated new diagnostic systems suggest that turbulence and self-organized plasma flows can be controlled and stabilized by external heating and feedback systems. Planned experiments may lead to a fundamentally new energy source for the future.



Science at the nanoscale seeks a fundamental understanding of nanoscale assemblies of materials—structures 1,000 times smaller than a human hair—where properties such as melting



point and electrical resistivity may differ greatly from those in the same materials with bulk dimensions. Lessons learned from 20th century studies of bulk materials do not apply here. Using materials fashioned atom-by-atom, we can then ask whether we can design and construct multi component molecular devices and machines having desired properties—optical, mechanical, catalytic, electrical, tribological. Can we use molecular building blocks to form the basis of systems such as nanometer-scale chemical factories, molecular pumps, sensors, and self-assembling electronic/photonics devices? New tools, new understanding, and a developing convergence of the DOE-supported

scientific disciplines will build on 20th century successes and allow us to ask and solve questions that were previously the stuff of science fiction.

High end computing and high temperature plasmas are being combined to dramatically expand our understanding of the fundamental processes of high temperature plasmas and our ability to predict the behavior of complex plasma systems. Within the next five to ten years, computers 1,000 times faster than today's will become available. Using such computers, it will be possible to dramatically extend our understanding of the fundamental processes of high temperature plasmas, as well as advance our ability to predict the behavior of complex plasma systems. The Office of Science established three integrated teams of plasma scientists and computer scientists to work on scientific areas essential to the development of integrated models of plasma dynamics in confining magnetic fields.

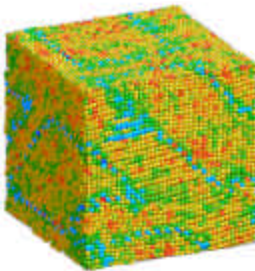
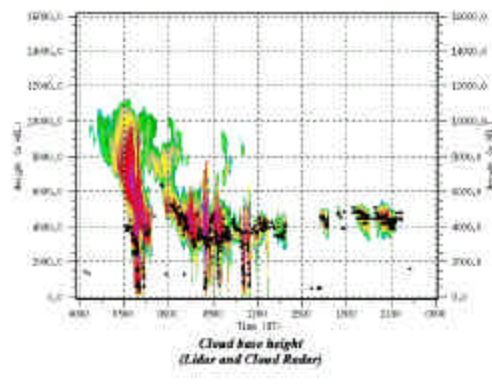
Recapturing world leadership in neutron science will be possible once the Spallation Neutron Source (SNS) is completed in 2006. SNS is a major user facility for basic and applied research, and for technology development using neutron scattering in the fields of condensed matter physics, materials sciences, magnetic materials, polymers and complex fluids, chemistry, and biology. It will be the world's most powerful, accelerator-based, pulsed

neutron source, producing 6-10 times more neutron flux than any other such source. Annually, it will be used by 1,000-2,000 researchers from academia, national labs, and industry. The \$1.4 billion construction project is a partnership among six DOE laboratories. SNS is currently under construction at Oak Ridge National Laboratory.



The Atmospheric Radiation Measurement

(ARM) program obtains field measurements and develops models to better understand and simulate the processes that control solar and thermal infrared heat transfer in the atmosphere (especially in clouds) and at the earth's surface. The goal is to develop models that will help scientists better understand and predict the natural and man-made influences on the earth's climate. ARM establishes and operates field research sites in several climatically significant regions: the U.S. Southern Great Plains, the North Slope of Alaska, and the Tropical Western Pacific.



Creating tools for scientific discovery is the goal of the Integrated Software Infrastructure Centers sponsored by the Office of Science. The Centers will play a critical role in enabling scientists across the Office of Science to make effective use of computers capable of trillions of operations per second as unique new tools for scientific discovery. These centers will enable scientists to close the gap between real and peak performance on these computers and study physical and biological systems with a

level of realism and accuracy that was impossible on earlier computers. These centers are one component of an integrated computational program that involves all the scientific programs in the Office of Science.

Each year, more than 15,000 university, industry, and government-sponsored scientists and engineers conduct cutting-edge experiments at state-of-the-art scientific facilities maintained by DOE for the common use of the scientific community. These particle accelerators, high-flux neutron sources, synchrotron radiation light sources, and other unique facilities are used to conduct basic research into the understanding of matter, design and fabricate new materials, and develop new pharmaceutical and industrial products. The FY 2002 request supports maintenance and modernization of key user facilities in Basic Energy Sciences, High Energy Physics, Fusion Energy Sciences, Nuclear Physics, Biological and Environmental Research, and Advanced Scientific Computing Research.



Intense Pulsed Neutron Source